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NOTES ON THE INTERNAL MORPHOLOGY OF EUCRANGONYX MUCRONATUS

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DIGESTIVE SYSTEM

The short oesophagus leads obliquely dorsad into the crop which is located in the head immediately posterior from the brain and extending posteriorly to the beginning of the first thoracic segment. The crop is irregularly rectangular in form with a chitinous framework well armed with teeth and stiff setae. (Fig. 1). It is divided into two parts, the cardiac and the pyloric. The cardiac division is smaller than the pyloric, being slightly shorter and a little more than one-half as wide. The opening from the oesophagus into the crop is guarded by two processes almost circular, one on either side of the entrance and reaching about half way to the median line. The process does not form a complete circle but is open anteriorly. The dorsal arc of the process is armed with curved toothed spines, the teeth on the curved posterior surface of the spines, and the ventral arc with setae. On the ventral wall of the cardiac portion of the crop is a deep U shaped portion of the framework, open anteriorly, with the chitin thickened on the outline of the U. This framework extends about three fourths the length of the cardiac division and is armed with strong setae curved caudad, overlapping on the median line. The cardiac division is much narrower dorsally than in any other part. Here the thickened edge of the framework curves gradually toward the side wall and is armed with short setae beginning near the middle of the length; the setae directed obliquely caudad increase in length toward the posterior part of the framework. The pyloric portion has a wide V shaped frame dorsally, the opening of the V toward the cardiac portion. The greater part of the length of the frame is supplied with long setae extending mesial and caudad. On the ventral wall of the pyloric part forming about four-fifths of its length, and projecting as a longitudinal ridge into the cavity of the crop is the "campaniform appendage" somewhat urn shaped with the base of the urn toward the posterior part of the crop. Short setae are numerous on the appendage and the side of the anterior three fourths shows num-

erous fine transverse lines and scattering minute setae. Viewed from the side the appendage is somewhat blade shaped, convex ventrally and concave dorsally. The crop viewed from the side shows the depth to be nearly the same through its entire length. Muscles are attached to the walls so it may be used somewhat as a triturating organ for which its spines and setae fit it. Some movements were observed in a living specimen. The processes guarding the entrance to the crop from the oesophagus are brought close together, the edges bearing the spines are moved posteriorly a short distance into the crop by a movement of the anterior end of the cardiac portion. The campaniform appendage is raised and lowered through some distance, the movement being somewhat obliquely backward and upward, and downward and forward. The upper surface of the appendage is brought quite close to the dorsal wall of the crop. These movements aid in the ingestion of the food as well as in its trituration.

The intestine has its origin from the dorso-posterior part of the pyloric division of the crop and extends as a straight tube to the posterior end of the body. Almost immediately upon the exit of the intestine from the crop it gives off the dorsal cul-de-sac which lies parallel with the intestine and extends anteriorly through the first thoracic segment ending blindly. Two hepatic cecae open upon either side into the intestine in the first thoracic segment by a common broad short duct near the opening of the cul-de-sac. The lobes of the hepatic cecae, two upon either side, extend posteriorly ending blindly in the third abdominal segment. The diameter of the lobes is little less than that of the intestine. (Fig. 2)

About midway of the fourth abdominal segment are the openings of the Malpighian tubules into the dorso-lateral side of the intestine (Figs. 3, 4). From the opening the tubules extend posteriorly to the middle of the fifth abdominal segment, then bend upon themselves toward the median line, pass anteriorly ending blindly in the posterior part of the fourth abdominal segment. A marked variation from the arrangement of the tubules just described was observed in one specimen. (Fig. 3) The left tubule extends some distance farther posteriorly than the right and the blind end is near the opening into the intestine. The right tubule opens into the intestine on the same level with the left but the blind arm of the tube is enlarged to a diameter about one sixth greater than the other arm and ends a little distance anterior from the opening into the intestine and in the median line of the body. Evidently more or less irregularity exists in the development of the tubules.

The tubules vary in diameter, in some being almost cylindrical, in others tapering slightly toward the blind end. In some older specimens the tubules are enlarged toward the blind end.

RESPIRATORY SYSTEM

The special structures for respiration are five pairs of thin elliptical lamellae attached by a short stalk to the bases of the second gnathopod and the first four peraeopods. The lamella of the second gnathopod extends nearly three-fourths the length of the basos, is oval in outline with a broad short stalk attaching it to the inner surface of the coxa. (Fig. 5) The lamellae of the first three peraeopods are broadly elliptical with broad short stalks, and they extend nearly to the distal end of the basos. The lamella of the fourth peraeopod is somewhat smaller extending about two-thirds the length of the basos. Between the third and fourth peraeopods and between the fourth and fifth are two pairs of accessory lamellae, slender with pointed ends and a little longer than the lamella of the fourth peraeopod.

CIRCULATORY SYSTEM

The heart is situated in the first five thoracic segments and extends forward into the head; a pulsating tube extends posteriorly from the heart. A pair of valves is present in each of the second, third, and fourth thoracic segments. The valves are elliptical with the long axis perpendicular to the heart. The general course of the blood is forward through the heart. Blood from the posterior segments is passed into the posterior dorsal vessel leading forward to the heart. From the segments of the thorax the blood finds entrance through the nearest valve. The course of the blood through the appendages, except the posterior three pairs of peraeopods, and the lamellae is, — out along the posterior side, in along the anterior side. In the lamellae there are numerous irregular channels from one side to the other through which the blood passes anteriorly to reach the incurrent channel. The posterior three pairs of peraeopods are reversed so the apparent anterior edge is in reality posterior. The outgoing stream of blood is along the anterior side and the ingoing along the posterior side.

NERVE SYSTEM

Adult. — The brain is situated anterior to the stomach almost filling the space between it and the anterior wall of the head. The long axis of the brain is at an angle of nearly 90 degrees with the ventral nerve cord. The procerebrum extends farther dorsally

than the other lobes and is almost two times as large as the first antennal lobe. It is divided into two lobes by a deep wide fissure extending ventrally from the dorsal side of the brain for about one third the distance to the oesophageal collar. The greatest width of the procerebrum is near the dorsal extremity. The first antennal lobes are next in size to the procerebrum and are separated the one from the other by a distance approximately equal to the latteral thickness of a lobe. They are broadest at the base and gradually taper to the nerve trunk. Ventral to the first antennal lobes are the second antennal lying slightly dorsal to the oesophageal collar and with the long axis parallel with the long axis of the ventral cord. The second antennal lobes are about two-thirds the size of the first antennal. The optic lobes lie posterior to the procerebral lobes connected with them. No optic nerve is developed. Extending posteriorly from the oesophageal collar is the ganglion chain of the usual Arthropod type. (Fig. 6) The abdominal ganglia are somewhat longer and more slender than the thoracic. The posterior abdominal is an enlarged elongated ganglion composed of the ganglia of the posterior three segments. Large nerves pass posteriorly from this ganglion. (Fig. 7) The ganglion cells of the system are mostly gathered into more or less rounded masses lying in contact with the punktsubstanz and giving off nerve fibers to it. In some cases as for instance at the posterior abdominal ganglion and upon some of the thoracic ganglia the cells are arranged in spherical masses connected with the punktsubstanz of the ganglia by distinct peduncles composed of nerve fibers. (Figs. 8, 9) Six groups of ganglion cells are on the post abdominal ganglion, two or more on each of the other ganglia. This arrangement of ganglion cells is more noticeable in younger than in older individuals. In some of the older specimens the mass of ganglion cells lies inside of a depression on the ventral side of the punktsubstanz almost surrounded by it but distinct from it except through the nerve fibers. In some cases the ganglionic cell mass is partly within the punktsubstanz and partly without, a strong constriction at the surface of the ganglion marking off one part of the cell mass from the other. The ganglion cells are arranged in distinct masses about the punktsubstanz of the brain.

Cross sections of the brain of the young E. mucronatus, length three to four m.m., show the head to be almost completely occupied by the brain, the ganglion cells filling most of the space between the punktsubstance and the wall of the head. Figure 10 is of a

transverse section passing through the optic lobe and showing at the periphery of the lobe some elongated nucleolated cells, embedded in the punktsubstanz, that represent modified hypodermal cells, the rudiment of an eye.

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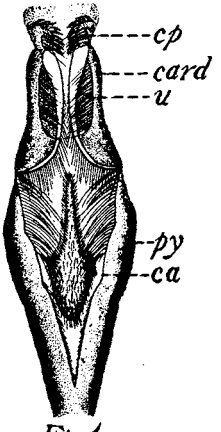

Fig.1

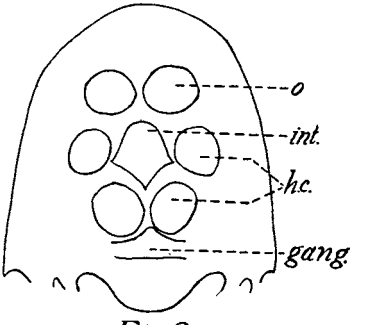

Fig.2

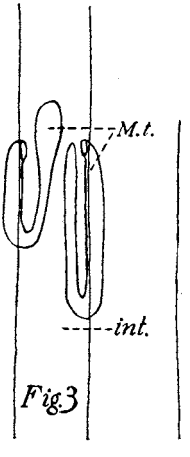

Fig.3

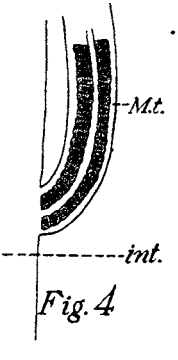

Fig.4

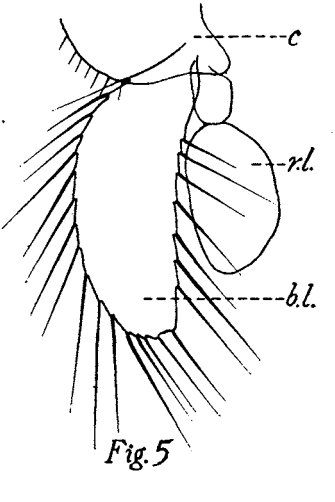

Fig.5

Fig. 1. Dorsal view of crop. cp, circular processes guarding entrance to crop; u, U shaped portion of frame work: py, pyloric division of crop; ca, "campaniform appendage."

Fig. 2. Cross section through third thoracic segment. o, ovaries; int, intestine; hc, hepatic cecae; gang, ganglion.

Fig. 3. Longitudinal intestine; Mt, Malpighian tubules.

Fig. 4. Longitudinal intestine; Mt, longitudinal section Malpighian tubule.

Fig. 5. Second gnathopod.

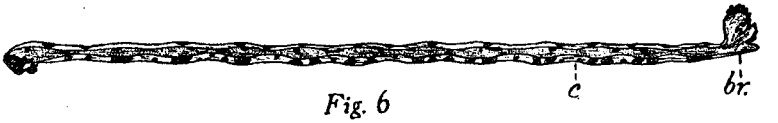

Fig. 6

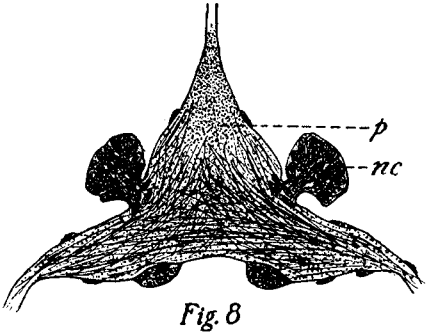

Fig. 8

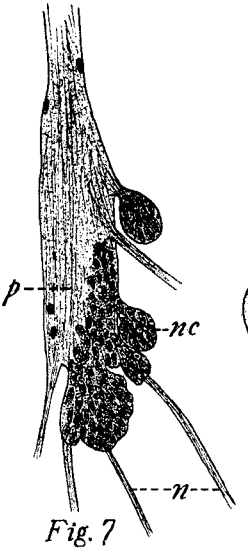

Fig. 7

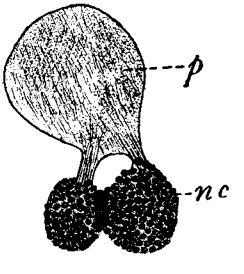

Fig. 9

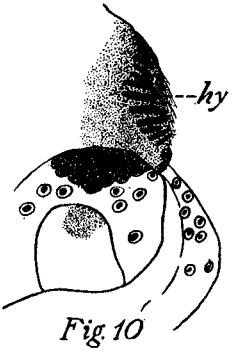

Fig. 10

Fig. 6. Lateral view brain and nerve cord, — diagramatic.

Fig. 7. Posterior abdominal ganglion. p, punktsubstanz; nc, nerve cell bodies; n, nerve.

Fig. 8. Cross section post abdominal ganglion. p and nc, as in fig. 7.

Fig 9. Cross section thoracic ganglion. p and nc, as in fig. 7.

Fig. 10. Rudimentary eye. hy, hypodermal cells, — udimentary eye.